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(54) Device for separating liquids and/or solids from a gas stream.

(57) The invention relates to a device for the separation of liquids and/or solids from a gas stream, comprising a cylindrical vessel with a virtually vertically set axis, provided with: a top compartment to which the gas stream is supplied; a middle compartment comprising a number of blades shaped helicoidally around the axis; a bottom compartment for the separation of the liquid and/or solids and a coaxial gas discharge pipe projecting upwards from the bottom compartment through the middle and top compartments, around which the helicoidal blades are fixed, in which bottom compartment at least one plate with a circular outer rim is provided perpendicularly to the axis of the vessel and under the gas discharge pipe, at least one diametrical baffle being provided beneath the bottom plate, the overall height of each baffle being at least 1.0 times the internal diameter of the vessel.

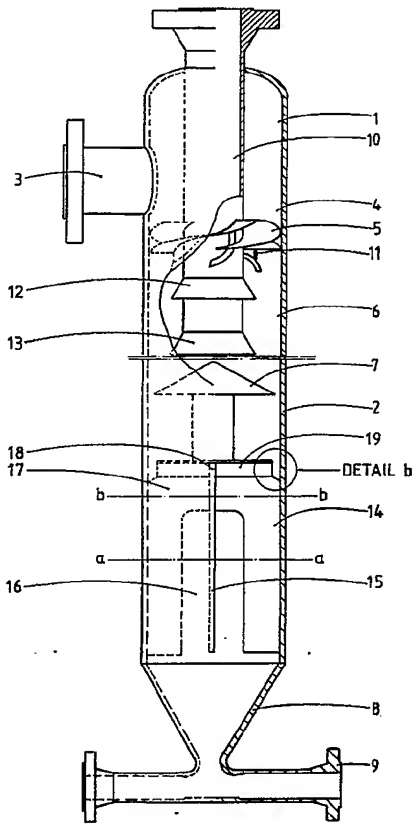

Fig.1

EP 0 436 973 A2

DEVICE FOR SEPARATING LIQUIDS AND/OR SOLIDS FROM A GAS STREAM

The invention relates to an apparatus for separating liquids and/or solids from a gas stream, comprising a cylindrical vessel with a virtually vertically set axis provided with:
a top compartment to which the gas stream is supplied; a middle compartment comprising a number of blades shaped helicoidally around the axis;
a bottom compartment for the separation of the liquid and/or solids and a coaxial gas discharge pipe projecting upwards from the bottom compartment through the middle and top compartments, around which the helicoidal blades are fixed, in which bottom compartment at least one plate with a circular outer rim is provided perpendicularly to the axis of the vessel and under the gas discharge pipe, at least one diametrical baffle being provided beneath the bottom plate.

Such a device is known from the United States patent 3,822,533. Such cylindrical separators are used particularly to separate impurities from gases at high pressures, for example pressures of over 8 bar.

These separators have the drawback that the separated materials are in violent rotation at the bottom of the vessel during operation. This causes abrasion or erosion of the bottom and the inner wall near the bottom. It also makes it difficult to discharge the separated materials. Moreover, already separated materials are entrained into the gas discharge pipe again. This phenomenon is known as reentrainment. Already separated liquids and/or solids are later blown from the cyclone again. This is particularly the case when liquids or solids contained in the reservoir are still in motion.
To remedy the drawback mentioned above the aforementioned United States patent 3,822,533 suggests to fit the separator with a large circular plate, set perpendicularly to the axis of the vessel and under the gas discharge pipe, at a relatively short distance therefrom, and to install further means under this plate for causing the separated materials to settle. For this reason this round plate is also called a settling plate. It has been found that the settling plate is effective, but not sufficiently so to completely suppress the rotation of the gas, and consequently of the separated impurities in the reservoir, and thus the erosion phenomenon. To this effect at least one diametrical baffle has been installed under the settling plate to further suppress the rotation of the gas. It has been found that fine moving particles are still entrained into the gas discharge pipe by the upward gas flow. To prevent this reentrainment it is desirable that these particles are also caused to settle.

The aim of the invention is to provide a device as mentioned in the opening paragraph, which is suitable for separating liquids and/or solids from a gas stream, in which device such provisions have been made that there is virtually no movement of fine particles at and near the bottom of the vessel, so that no solids are entrained into the gas discharge pipe.

This is achieved according to the invention because the total height of each baffle is at least 1.0 times the internal diameter of the vessel.

Preferably, there are two diametrical baffles, set perpendicularly to one another. The effect of the installation of these baffles is that the gas is set at rest at and near the bottom of the vessel and consequently the separated liquids and/or solids are caused to settle. There is virtually no more movement of fine particles, which means that the phenomenon of reentrainment is virtually suppressed.

The total height of each baffle is at least 1.0 times the internal diameter of the vessel.
Preferably, each diametrical baffle is provided with a slot, which extends from the bottom edge of the baffle and is symmetrical with respect to the axis of the vessel. These slots in the baffles serve to facilitate the cleaning of the reservoir. The separated liquid and solids constitute a pasty substance, which would be difficult to remove in the case of baffles without slots. The slots in the baffles also prevent caking of the pasty substance, which occurs particularly at the intersections of the baffles. Moreover, there would be no unimpeded upward flow of the purified gas to the gas discharge pipe. The slot in each baffle is preferably rectangular and the height of the slot is at least 0.6 times the internal diameter of the vessel.
The height of the part of the diametrical baffle that extends from one wall of the vessel to the other is at least 0.4 times the internal diameter of the vessel.
The size of the slot measured in the direction perpendicular to the axis of the vessel is 0.25 to 0.5 times the internal diameter of the vessel.
The distance from the bottom edge of the settling plate to the top edge of the vertical baffles is at least 0.5 times the internal diameter of the vessel.
Preferably, the top edge of each diametrical baffle is partly free from the inner wall of the vessel.
The reason for this is the suppression of turbulences.

The bottom of the vessel is preferably conically shaped in the direction of the discharge pipe for the separated liquids and/or solids. In this way a more steady discharge is obtained of the separated

liquids and/or solids caused to settle by the diametrical baffles.

Other characteristics and advantages will become apparent from the following description, in which reference is made to the appended drawings. In these drawings:

Fig. 1 is partially a vertical section of the separator and also a detail thereof;

Fig. 2 is a cross-section of the separator along the line a-a;

Fig. 3 is a cross-section of the separator along the line b-b, and

Fig. 4 is a cross-section of the vessel at detail b in Fig. 1.

The gas to be purified is fed to the top compartment 1 of the separator 2 via inlet 3. A rotary motion is imparted to the gas by the blades 5 in the middle compartment 4, for the purpose of converting the flow energy of the gas into a centrifugal force, required for the separation. The separated liquid and/or solids collect against the inner wall 6 of the vessel 2 and then move downward and are caused to settle by the plates 7. The separated material is discharged via the conical bottom 8 and the pipe 9.

The purified gas is discharged via the gas discharge pipe 10, which is mounted coaxially with the vessel 2 and projects upwards from the bottom compartment 6, through the middle compartment 4 and the top compartment 1. The helicoidal blades 5 are attached to the gas discharge pipe 10 at some distance from one another and partially overlap one another, thus creating the desired curved channel. Each helicoidal blade 5 is composed of a bottom section with a constant pitch and a section with a pitch that gradually increases in upward direction. This causes a gradual acceleration of the gas fed into the separator 2, which results in a smaller pressure drop when the gas is caused to rotate.

Between the blades 5 are vertical baffles 11, which, viewed in the flow direction of the gas, extend from the gas discharge tube 10 in the direction of the inner wall of the vessel 2. These baffles 11 are shaped like flat planes. These baffles improve the liquid separating capacity. This is improved even more when the free ends of the baffles are sharp.

To further improve the separation of the liquids from the gas, conical sleeve sections 12 and 13 are fixed to the outer wall of the gas discharge pipe 10 in the separation section 6 of the vessel 2. These sleeve sections serve as so-called anti-film skirts, that is, liquid adhering to the outer wall of the gas discharge pipe 10 is guided along these conical sleeve sections in the direction of the wall of the vessel 2.

The aim of the settling plate 7, which is here shaped like a conical plate, is to cause the liquids and/or solids separated from the gas to settle. In the absence thereof, the separated liquids and/or solids would be in violent rotation at the bottom of the vessel. This would cause erosion of the bottom and the inner wall near the bottom. It has been found that the plate 7 is effective, but insufficiently so to completely suppress the rotation of the gas in the reservoir, and thus the erosion. To this effect, diametrical baffles 14 and 15 are installed perpendicularly to one another under plate 7. The effect of these baffles is that the gas and, consequently, the separated liquids and/or solids are set at rest at and near the bottom 8 of the vessel 2. The overall height of each of the baffles 14 and 15 is at least 1.0 times the internal diameter of the vessel 2. As Figures 1 and 2 show, each baffle 14 and 15 has a slot 16, which extends from the bottom edge of the baffle and is symmetrical with respect to the axis of the vessel. The aim of these slots 16 in baffles 14 and 15 is to facilitate the discharge of the pasty substance formed by the separated liquids and solids and to avoid caking hereof. Such caking occurs with baffles without slots, particularly at the intersection of the baffles. Moreover, the upward flow of the purified gas to the gas discharge pipe 10 is impeded less.

The slot 16 in each of the baffles 14 and 15 is rectangular and the height of the slot is at least 0.6 times the diameter of the vessel 2.

The height of the parts 17 and 18 of the diametrical baffles 14 and 15 which extend from one of the walls of the vessel to the other wall is at least 0.4 times the internal diameter of the vessel 2. The size of the slot 16 in the direction perpendicular to the axis of the vessel is 0.25 to 0.5 times the internal diameter of the vessel 2.

The distance from the bottom edge of the settling plate 7 to the top edge of the vertical baffles 14 and 15 is at least 0.5 times the internal diameter of the vessel.

As Figures 1 and 4 show, the top edge 19 of each of the baffles 14 and 15 is partially free from the inner wall of the vessel 2. This has been done to suppress turbulences. The bottom 8 of the vessel 2 is conically shaped. This results in a more steady discharge of the separated settled liquids and/or solids.

With the device according to the invention the fine particles are also caused to settle and are thus virtually not entrained into the gas discharge pipe.

Claims

1. Device for the separation of liquids and/or solids from a gas stream, comprising a cylindrical vessel with a virtually vertically set axis, provided with: a top compartment to which the gas stream is supplied; a middle compartment

comprising a number of blades shaped helicoidally around the axis; a bottom compartment for the separation of the liquid and/or solids and a coaxial gas discharge pipe projecting upwards from the bottom compartment through the middle and top compartments, around which the helicoidal blades are fixed, in which bottom compartment at least one plate with a circular outer rim is provided perpendicularly to the axis of the vessel and under the gas discharge pipe, and at least one diametrical baffle being provided beneath the bottom plate, characterized in that the overall height of each baffle is at least 1.0 times the internal diameter of the vessel.

2. Device according to claim 1, characterized in that it is provided with two perpendicular diametrical baffles.

3. Device according to either one of claims 1 or 2, characterized in that each diametrical baffle is provided with a slot that extends from the bottom edge of the baffle and is symmetrical with respect to the axis of the vessel.

4. Device according to claim 3, characterized in that the slot is rectangular.

5. Device according to claim 3 or 4, characterized in that the height of the slot is at least 0.6 times the internal diameter of the vessel.

6. Device according to any one of claims 3-5, characterized in that the height of the part of the diametrical baffle that extends from one wall of the vessel to the other is at least 0.4 times the internal diameter of the vessel.

7. Device according to any one of claims 3-6, characterized in that the size of the slot in the direction perpendicular to the axis of the vessel is 0.25 to 0.5 times the internal diameter of the vessel.

8. Device according to any one of claims 1-6, characterized in that the distance from the bottom edge of the plate to the top edge of the vertical baffles is at least 0.5 times the internal diameter of the vessel.

9. Device according to any one of claims 1-8, characterized in that the top edge of each diametrical baffle is partially free from the inner wall of the vessel.

10. Device according to any one of claims 1-9, characterized in that the bottom of the vessel is conically shaped in the direction of the discharge pipe for the separated liquids and/or solids.

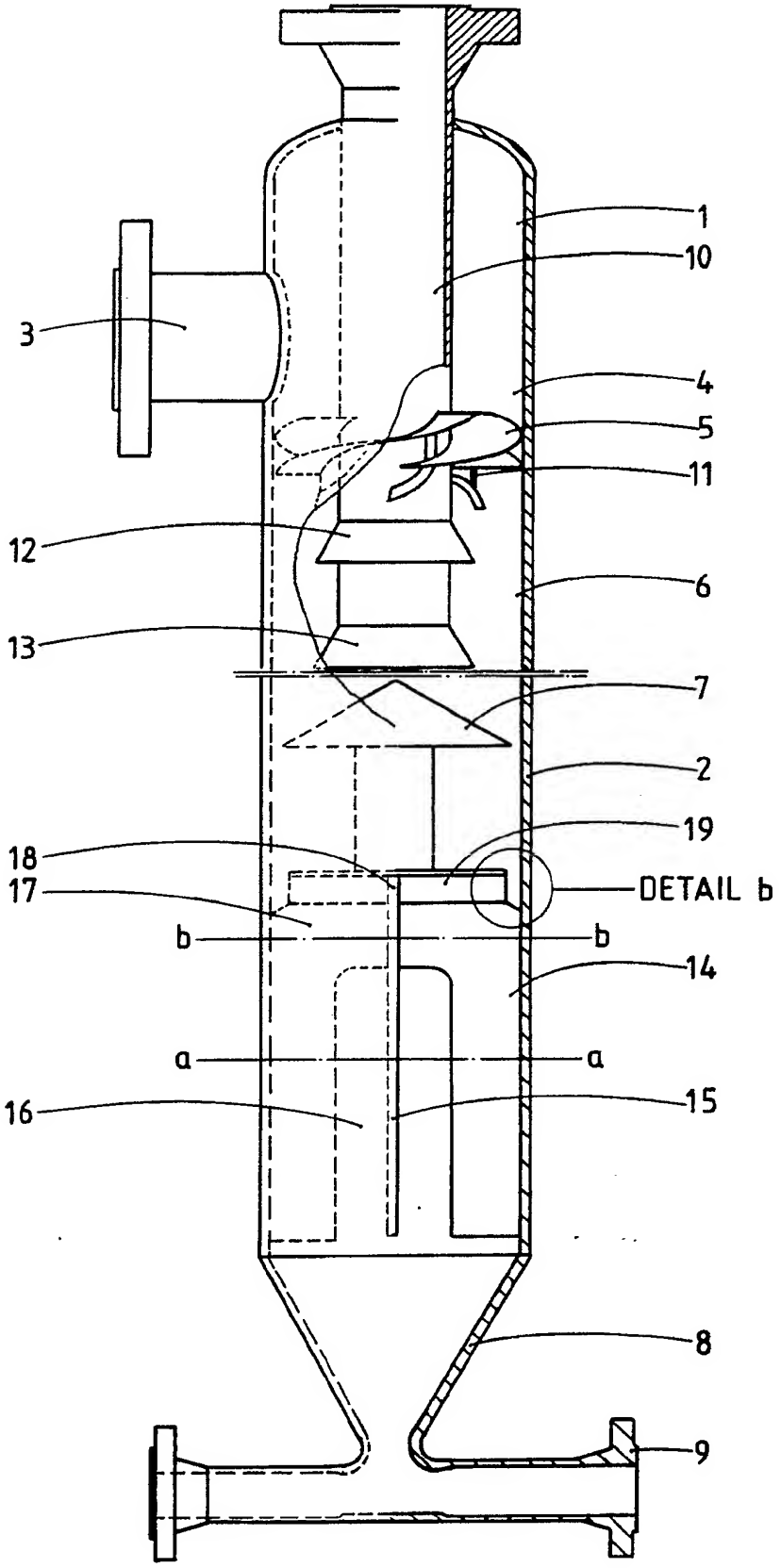

Fig. 1

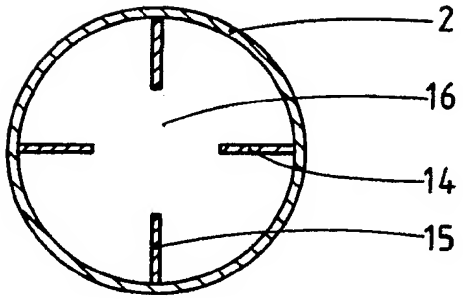

Fig. 2

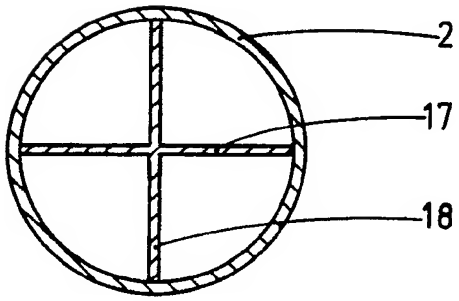

Fig. 3

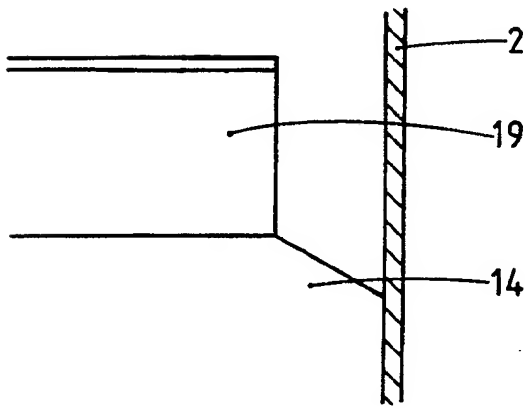

Fig. 4